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ON THE DESCRIPTIVE METHOD OF LINNAEUS*

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(Plates 990 and 991)

"There are as many various forms in the world as there are individuals, and no two are found which are perfectly alike; therefore Nature may be said to display herself in variation . . . The older naturalists saw that there was order in nature which consisted in the similitude of things, but they were unable to combine the similar and to separate the dissimilar. They saw the chain of nature but could not forge the links. The links of this chain . . . the Creator has thrown into the world without order; thus it is of wisdom to inquire into these, and to search out their similitudes and dissimilarities and to combine those which should be combined; whence at length results the *Ordo naturalis*, which presents the mundane things mutually combined so that an affinity of these appears, which extending itself throughout the whole reign of Nature is the ultimate end of the systematic order". From *Introductio ad Ordines Naturales Linnaei*, Mss. Fabricius (1792), ed. Schuster, 1926.

Species Plantarum, published in 1753 by Carl Linnaeus (1707–1778),¹ has been chosen as the starting point of modern botanical nomenclature, and as such it represents perhaps the most important work in systematic botany. But various interpretations show that there is not a clear understanding of the method by which the book was written, and of its purpose. Consequently there have been many unnecessary changes of names in recent times, due primarily to a lack of understanding of Linnaean procedure. The subject is therefore of vital importance in the development of a stabilized nomenclature, a goal toward which all systematic botanists are bent, at least nominally. Spring (Ueber

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¹ In formal Latin this becomes "Carolus Linnaeus"; the form "Linné", obviously of French origin, was later in common use by Linnaeus.

die naturhistorischen Begriffe von Gattung, Art, und Abart und über die Ursachen der Abartungen in den organischen Reichen. Leipzig. 1838, pp. 14-24) gives a good general account of pre-Linnaean nomenclature. Of Linnaeus (p. 18) he says: "What he differed in from all his predecessors, and what will always remain as his greatest accomplishment is the *sequence* with which he built up a system of nature, and the precision and clarity with which he formulated the rules and principles of the subject. In this respect he has been the law-giver for all succeeding time."

By Linnaeus *Species Plantarum* was looked upon as a compendium without descriptions, except in some ambiguous² cases, and the number of species *described* within its covers was relatively few. The names of species go back in general to earlier dates, usually within the fifty to eighty preceding years, and especially to Linnaeus' earlier works. Many names were based upon illustrations. Where there is a description to be found, Linnaeus marks the reference with an asterisk. Binomial nomenclature was not intended by Linnaeus to supersede the polynomial specific name, and Linnaeus when later citing specific names used the binomial no more than he did the polynomial nomenclature. Despite statements in text books the polynomial specific name, especially as developed by Linnaeus³, was not so cumbersome and could readily be cited by use of dots for the abbreviated portion. No one would want to give up the binomial system of today, but that does not preclude the fact that modern botanical nomenclature lacks some of the flexibility of the Linnaean polynomial.

Much of the misunderstanding of the Linnaean method is due to a lack of comprehension of definitions⁴. The term "method"

² No definite explanation of the word "ambagibus" is given by Linnaeus, but its application is apparent once the usage of the Linnaean term "descriptio" has been recognized. On page 18 of the preface to *Flora Zeylanica* (1747), Linnaeus mentions both *obscure* and *dubious* plants. *Obscure* plants are defined as those of which the fructification is but little, or insufficiently, known; in *dubious* plants the fructification is lacking. These terms apparently were not carried over into *Species Plantarum*.

³ Composed of not more than twelve words, differentiating the species from all others of the genus according to rules laid down in *Critica Botanica* (1737). *Differentiae* were called "essential" when only a single idea was emphasized, as *Claytonia foliis linearibus*, or synoptic when (as in large genera) a series of ideas was necessary.

⁴ Linnaeus was a rapid worker, and at times careless in details, especially as to bibliographic references. Many of these minor errors were corrected in the second edition of *Species Plantarum* (1763), but some of the mistakes ascribed to him were rather the mistakes of recent interpreters. Such, for example, is the idea that *Scirpus geniculatus* was based on the plant with rounded spikelets, or that *Dioscorea sativa*

applies here to a formal arrangement of material especially dealing with phrase-names and synonymy, such as, for example, Gronovius employed when he followed the Linnaean "method" in his *Flora Virginica* (1739). The term "specific name" applies only to the phrase-name⁵. This has been more clearly recognized in recent years, and the term "specific epithet" is sometimes used in place of the Linnaean "trivial name". The term "description" applies to an actual, more or less detailed, description of the plant.⁶ Short comments following a discussion of a species in *Species Plantarum* should be classed as "observations". Examples of the *descriptio* are given in *Philosophia Botanica*, that of *Passiflora foetida* being considered by Linnaeus as ideal. The

is an oriental species. The latter is unknown in the Old World, as the species of the genus are recognized in modern literature, and nearly all of the Linnaean references point to a New World species, which the habitat "in Indiis" does not preclude. The editing of some of Linnaeus' works was done hurriedly and sometimes by students. In a letter to Beck (Hulth no. 785; May 29, 1753) he says of *Species Plantarum*: "Salvius demanded a prompt recension. I asked a student to make it. Salvius improved it." Kalm, writing on Oct. 15, 1752 (Hulth no. 1614) urged Linnaeus to write a "Synonymia Plantarum", offering "to take it upon myself to edit half the book, though I should have to sit night and day to write; only so that the book might come out".

The exacting and often discouraging task of writing *Species Plantarum* was carried out in the years 1749–1752, and its progress may be followed in letters to Beck (edited by J. M. Hulth, 1909) from which excerpts are quoted in translation. No. 671, Oct. 6, 1749: "I am beginning to drop *Species Plantarum* from my mind; since autumn I have not had time to look at it. I have worked along to the *Polyandria*, but it will be impossible with a whole year's steady work to finish them. I feel like leaving what is done as an inventory after me, so that posterity might see that I could have done it if I had had the time and energy. Why should I work myself to death and lose contact with the world? What does one gain? One does not become wise till the end". No. 728, Nov. 12, 1751: "I am working on *Species Plantarum* and have come to *Icosandria*". No. 738, Dec. 1751: "I am like a setting hen on its eggs, hatching out species, but the hatching time is much longer, so that I have got only to the *Diadelphia*, though I work night and day". No. 741, March 6, 1752: "Now I have reached to the *Syngenesia* with my *Species*, and think I shall rest for a few days". No. 752, June 5, 1752: "I have finished my *Species*".

⁵ It is strange that a person as well versed as DeCandolle (*Théorie élémentaire de la Botanique* 1813, p. 223) should have so misunderstood the situation: "Linné . . . propose . . . que le nom d'un être naturel serait composé de deux mots: le premier, qu'il appela le nom *générique*, serait commun à toutes les espèces d'un genre; par exemple, *Rosa*, *Trifolium*; le second, qu'il nomma *spécifique*, devait être propre à chaque espèce d'un genre."

⁶ cf. Richter, *Codex Botanicus Linnaeanus*, p. xi. (1840): "Signum* in Spec. pl. adhibitum, teste praefatione significat *descriptionem* in aliquo citato opere dari . . . Hoc signo nonnulli, qui leviter inspexerant *Species Plantarum*, decepti sunt, ut crederent opus praecipuum et prae ceteris fidum eo indicare, id quod nunquam in mentem venit Linnaeo." [The asterisk, used in *Species Plantarum*, signifies (according to the introduction) that a description is given in the work cited. . . . By this sign, some who have casually examined *Species Plantarum* have mistakenly believed that a work more important than the others was indicated by him, something which had never entered Linnaeus' mind].

term "diagnosis" does not occur in Linnaean works except in connection with the generic name; it has been adopted by some as a substitute for the Linnaean specific phrase-name, but in modern usage it may lack entirely the differential character of the Linnaean specific phrase-name. There is nothing to support the statement of some botanists that a new specific phrase-name ("diagnosis") was based upon herbarium specimens which Linnaeus had before him. The new specific name was, on the other hand, a most important feature in the Linnaean method, by which old phrase-names were brought into conformity with the other specific names in the genus, in whatever new work was under way by Linnaeus or his collaborators.⁷ Such new specific names, quite obviously, do not constitute a quotation from some previous work, as do the majority of Linnaean specific [phrase] names in *Species Plantarum*. The Linnaean specific name was not only a definition of the species, but essentially an all-inclusive key to the species, corresponding to the distinctions in dichotomous keys of our current manuals. A new specific name represented either a new species or the reformation of an older specific name; in the latter case the old name became a synonym taking its place at the head of the list. Such synonyms were *names*, in general comprehensive and accumulative, i. e. including various figures, descriptions and specimens, and were not ordinarily, as in modern usage, based on single specimens. The Claytonian reference in Gronovius' *Flora Virginica* was not a true synonym; it was a brief description of the Clayton specimen, now being assigned to a proper specific name under the Linnaean method. These descriptive notes, accompanying specimens, which Clayton wrote in English, were translated into Latin by Gronovius and appended to his treatment of the individual species. Misunderstandings as to the nature of Gronovius' synonyms have led, in the author's opinion, to many unnecessary changes in the names of American timber trees, and this subject is therefore one of great practical importance. This procedure will be discussed in detail under the heading "The Species".

⁷ Cf. *Fl. Suecica* (1745), introd.: "The majority of the specific [phrase] names are new. I have sometimes changed specific names, not because I considered the previous ones as erroneous, but because these new ones are clearer and easier to understand. When more species have been observed and their outstanding characteristics detected, and more apt terms struck, it will be necessary sometimes to emend the differentiae, though previously they may have been very good."

Whatever thread is followed into the tangled skein of comment and literature on the *Species Plantarum*, general conclusions or points of view are reached that would also have been attained by some other angle of approach. The term "method" is a comprehensive one, but, as I have stated, it has a certain connotation in respect to the Linnaean works. I have found it expedient to treat the subject both from a historical point of view and as an elaboration of the important elements of the method. Perhaps the most outstanding asset of Linnaeus was "common sense". In the reforms of botanical nomenclature which will come within the next few decades, I believe the method of Linnaeus will play an important part. Since so much has been written about the artificial as compared with the natural system of botany, I have included at the end a resumé of the Linnaean natural system, as recorded by his students, Fabricius and Giseke. It will be seen that many things that the present-day botanist thinks of as recent developments, such as the reticulate nature of evolution, and graphic presentations of the relationship between families and genera, had already been elaborated by Linnaeus and his students. It is strange that no botanist to whom I have shown Giseke's account in the course of the last ten years (during which I have from time to time been occupied with this paper) had ever seen, or more than glanced at the work.

As early as the spring of 1733, Linnaeus (then twenty-six years old and recently returned from his Lapland journey) had preliminary drafts of *Species Plantarum* and a general outline of the botanical works, that he was to publish from time to time. To Cronhjelm⁸, then chancellor at Lund, he wrote:

"I have worked with the greatest diligence on a new System, based on a wholly new principle. Having assembled a herbarium of some thousand plants, I have examined as many species as possible, with dissection of three to four thousand flowers. From this work has come six or seven small volumes, including *Bibliographia Botanica*, which shows at a glance what each botanist has written, and an account of all previous botanical systems; *Philosophia Botanica*, which sets up rules, with examples, showing

⁸ cf. T. M. Fries, *Bref och Skrivvelser af och till Carl von Linné*, vol. 1, pt. 5: letter no. 1233. Vol. 1 (1907-1922), containing letters to and from correspondents in Sweden, consists of 8 parts but reaches alphabetically only through Laxmann. There are 1670 letters in this volume of which parts 7 and 8 are by J. M. Hulth. He also edited the second volume, which contains correspondence with foreign botanists, but reaches only from Adanson through Brünnich.

the reasons for many botanical errors, which are now becoming aggravated; *Homonyma Botanica*, dealing with all the names of plants which botanists have postulated (in large measure groundless), and showing that of 2000 generic names scarcely 200 are correct, and of some 1000 species names hardly 100—since botanists have not understood varieties which they hold to be distinct species; *Species Plantarum*, in which I intend to show that though botanists pride themselves on having 20,000 plant species⁹, there are not more than 8000 when varieties have been placed under their proper species. Each species is to be recognized at first glance without the presence of description or figure".¹⁰

This new method was not perfected until 1753, with the publication of *Species Plantarum*. The species contained in this work were derived from five sources:

1. Publications dealing with plants which Linnaeus had seen growing under natural conditions, as *Flora Suecica* and *Flora Lapponica*.
2. Publications based on cultivated plants which Linnaeus had seen in a living state, as *Hortus Cliffortianus* and *Hortus Upsaliensis*.
3. Publications based on herbarium specimens, as Gronovius' *Flora Virginica* and Linnaeus' *Flora Zeylanica*.
4. Specimens in Linnaeus' own herbarium and in the herbaria of other botanists.
5. Figures, such as those of Plukenet, and of Cornut's *Canadensium Plantarum Historia* (1635), and Sloan's *History of Jamaica*, of which Linnaeus had seen no herbarium specimens.¹¹

⁹ Compare the notation in the introduction to *Species Plantarum*; "I have judged with satisfactory calculation that the number of species in the entire world is much less than is commonly believed, and that it hardly reaches 10,000". Considering this figure, it must be kept in mind that Linnaeus' conception of species in general was a much broader one than that of the present day. According to A. P. DeCandolle (*Théorie élémentaire de Botanique* 1813) Linnaeus had 7540 species in 1260 genera in the second edition of *Species Plantarum* (1763). On page 23 DeCandolle says: "There are 30,000 species of plants known in the world; 40,000 if we include all that are unnamed in our collections; and there will probably be more than 60,000 when all the continents are well investigated."

¹⁰ In the preface to *Critica Botanica*, written from Clifford's Museum in 1737, Linnaeus states: "As to specific names I have mentioned hardly any examples, since there are but few that are meritorious, and to very few botanists (even at this date, when we take pride in a flourishing botanical science) is it certain which plants are varieties and which are species; therefore in *Hortus Cliffortianus*, which is soon to be published through the liberality of my generous patron, I have worked hard to reduce varieties to their species, and to provide the species with specific names."

¹¹ Of the nineteenth century botanists, C. B. Clarke had perhaps the best understanding of Linnaean procedure. In *Journ. Linn. Soc. Bot.* 30: 299. 1894, he writes: "A 'species' in his *Sp. Pl.* is made up of 4 (or fewer) parts, viz. (a) the citations of his predecessors; (b) the citations of pictures; (c) the diagnosis of Linnaeus himself; (d) the authentic examples in Linnaeus's herbarium. Perhaps the most important of these four is the first: Linnaeus meant invariably that his species should be the sp.

Here is bound up the most significant feature of *Species Plantarum*, a recension of previously published work [of comparatively recent authors], in which species are for the first time¹² differentiated. Previous works such as Bauhin's *Pinax* had treated various "kinds" of plants as units of equal rank. A corollary to this idea, as Lindman and E. L. Greene have already pointed out, is that varieties were first distinguished from species by Linnaeus.

In *Species Plantarum*, the species are treated from a wholly practical point of view. It was not meant to be otherwise. As a philosophical treatise on the species problem it offers little or nothing; the work is an artificial¹³ system based on the number of pistils and stamens, which, as Linnaeus was wise enough to see, could not in his day be replaced by a natural system satisfactory for the practical identification of plants.

From a philosophical point of view Linnaeus was clearly a disciple of Ray, and through Ray, of Morison. It may be added that the technical approach of *Species Plantarum*, the *methodus*, is modeled also on the work of Ray. Linnaeus' philosophical concept of species follows quite a different trend from that of *Species Plantarum* and is based mostly on experimental evidence; Ray's work forms the basis of the *Critica Botanica* and the *Philo-*

auct. of his day; Linnaeus generally draws his diagnosis by directly copying from his predecessors, only altering it so far as to make it include his authentic specimens."

¹² This does not include such fragmentary forerunners as Linnaeus' *Amoenitates Academicae* and *Flora Suecica*, the treatments of which were usually incorporated directly into *Species Plantarum*.

¹³ This was only one of a number of artificial systems current at the time (cf. the fructification system of Hermann, the calyx system of Magnol, and the corolla system of Rivinus. These various systems formed the taxonomy of DeCandolle (1813), p. 24: "After having devised successfully in many groups the individual names of the plant world, we arrive at a sure means of identifying those which interest us: it is this part of plant study which I designate by the name *taxonomie botanique*." Practically all parts of the plant were used in various schemes. Thus, as Usteri (*Magazin für die Botanik* 1: 15-48. 1787, under the title *Nachtraege und Fortsetzung der Linneischen Sammlung botanischer Systeme*) says (p. 16): "To proceed along the way that had been shown, and to make it the more passable, was the effort of every worthy botanist. But the nature of the thing was such that they did not work together, but went along different ways; this differentiation was, however, only superficial—for fundamentally they all worked toward the same goal—and in order to attain this goal, all the various ways had to be used, for by one way alone it could not be achieved. These various ways were the fundamental parts upon which they built their divisions, and such a foundation every part of the plant could give. There are systems which are based on all observed parts of the plant, at least in contemplation, and the greater number of them have already appeared."

sophia Botanica, as these works deal with the fundamental problem of species. The "constancy" of species as stated in Linnaeus' earlier works was an answer to the "transmutation" ideas of the naturalists who came before Redi, and whose influence still lingered on into the eighteenth century.¹⁴ In rejecting ideas of direct transmutation of species, which had been based on faulty experimental evidence, Linnaeus was abreast of, or ahead of his time—as a matter of fact no one up to the present time has directly perceived the transmutation of one species into another.

It is quite fitting to quote here Chapter xxi of Ray's *Historia Plantarum* (1704), in translation:

"Plants which derive their origin from the same seed, and again propagate themselves in sowing, we may consider as belonging to a single species; for those variations of leaves, colors of roots, taste, or even colors of fruits and seeds, we conclude to be neither characters nor indices of what is called specific diversity. But this quality, however constant it may be as a sign of species, is not perpetual or infallible. Experiments have been made to try to show that some seeds degenerate and produce plants, though rarely, of diverse species from the mother Galen once sowed *Triticum* and *Hordeum*, and having selected out all of the seeds which were admixed, he could with certainty tell whether *Lolium* and *Aegilops* had arisen from a 'mutation' of these, or whether each had its own appropriate seed. For, if by chance one of these made its appearance among pure seeds, as *Lolium* frequently does among *Triticum*, or the vigorous *Aegilops* among *Hordeum*, the aggressor was evident These experiments, from various workers both ancient and modern, appear very similar to some of our own; partly because through error the cause was not recognized, partly because they owe their origin to philosophers or the overcredulous or to the less circumspect in tracing a phenomenon to its causes—for these reasons we hold these experiments as uncertain and suspicious. Thus we think that the father of Galen was deceived in the rationalizing of phenomena. For it does not follow that because *Lolium* is often found in *Triticum* that the *Triticum* has changed into *Lolium*: the *Lolium* might well have arisen from *Lolium* seed from a previous year. And so as to the *Aegilops*: I myself have observed that in a certain field where pure *Triticum* had been sowed, that the potent *Aegilops* had lain fallow after a whole year. Then the *Aegilops* owes its appearance to its own seeds and not to those of *Triticum*". And on p. 40: "Thus as to plants of specific conformity: there is certainty that they came from the seed of the same plant, whether as species or individual. For those which differ as species preserve their species in perpetuity, and one does not arise from the seed of the other, or vice versa."

This problem and the associated problem of the continuity of species was discussed by Hornborg under the supervision of Linnaeus in volume 5 of the *Amoenitates Academicae* (1757):

¹⁴ This situation is well described by Bateson, *Problems of Genetics*, p. 3, 1913.

"The ancients thought that many plants were produced from seeds sown at the creation of the earth, when they observed various plants springing forth from soil recently dug up. Some thought that pines, when burned, turned into oak; others thought that fungi, mosses and other minute plants, as well as minute animals, originated by spontaneous generation, or by putrefaction or fermentation. This hypothesis endured until the time of Harvey, who dared to assert that all life came from the egg, and was similar to the mother . . . Nor was Redi able to obtain animalcules in putrid meat unless insects had access to lay their eggs". And in part x: "Turning our attention to plants we see the trunk of the tree extending into branches. We may compare this type of multiplication with that of *Taenia*, where any single articulation may produce a new individual . . . Or we may compare it with *Sertularia* . . . Similarly to be compared are the roots of grasses and cereals which have numerous joints creeping below the surface of the ground; . . . these plants often form gemmules which reproduce the entire plant. What mortal has ever seen a branch of a tree, of herb, of grass, or any other vegetation, however much it may be dissected, ever change its nature, or produce other plants or species? *Ligustrum*, *Tilia*, or any other tree may be repeatedly trimmed by the topiarist, as is the custom in our gardens; but no mortal has ever seen new branches of any different species regenerate . . . Nature is a law of God; constant, ever constant, is this law of nature, that organisms give rise to similar ones, and that ferocious eagles do not produce peaceful doves". Cf. also one of Linnaeus' letters to Beck (Hulth no. 657, written in 1746): "It is apparent that polyps lead a vegetable life. They increase by seeds as do plants; they increase by stems or roots as do *Salices*. Good God! the animal and vegetable kingdoms approach each other so much that we shall soon have to have a new set of surveyors to make the division lines".

These introductory statements on the constancy of species, as seen by Linnaeus in his earlier years, may be brought to a close with the related philosophical arguments on the nature of varieties, propounded by Linnaeus in section 271 of *Critica Botanica* (1731):

"All species number their origin first from the hand of the Omnipotent Creator: for species having been created, the Author of Nature has imposed the eternal law of generation and multiplication within the species itself. It is conceded that the external appearance often deviates, but there is never a metamorphosis from one species into another. Hence there is today a double differentiation among plants; one a diversity produced by the wise hand of the Omnipotent, the other of sportive Nature, showing variety in the external crust. If the garden is sowed with a thousand diverse seeds, the diligent care of the gardener aids in the production of monstrosities; and after some years it will contain six thousand varieties, which the ordinary botanist calls species. I therefore distinguish species of the Omnipotent Creator or true species from the monstrous varieties of the Horticulturist . . . These monstrosities luxuriate in variegations, multiplications, doublings, proliferations, and fascinate the eyes of the beholders with their protean variation, as long as the gardeners make daily sacrifices for their idols. If they are neglected, these ghosts of variability fall into ruin."

THE GENUS

The *Genus* was elaborated in Linnaeus' *Genera Plantarum* (1737)¹⁵. As I have pointed out, it may be considered the oldest of the botanical groups. Genera of Bauhin contained, more or less indiscriminately, items which were placed by Linnaeus under their proper species and varieties. Generic names frequently came from Tournefort or even older writers, but some were based on collections of Gronovius and the American plants obtained by Kalm. Thus in *Amoenitates Academicae*, generally accepted as the work of Linnaeus¹⁶, his student Chenon (3: 1-27. 1751) states under the title "Nova Plantarum Genera": "Since Professor Kalm, lately returned from Canada, has detected many new genera . . . (p. 3), with these brief remarks I proceed to propose as new those genera which are established by Kalm's plants, together with his notes which were communicated to me." These new genera are: *Lechea*, *Sarothra*, *Alethris*, *Helonias*, *Dirca*, *Kalmia*, *Gaultheria*, and *Polymnia*. These genera were incorporated without further change into the first edition of *Species Plantarum*, an example (*Lechea major*), being as follows:

2. *Lechea* foliis ovati-lanceolatis, floribus lateralibus vagis.
Gen. nov. 1074. f. 4*.
Habitat in Canada aridis.

The *genus* and *species*, under the Linnaean method, were the stable and fundamental categories, i. e. they were "natural" units (*Philosophia Botanica*, section 162). Superior groups, the *class* and *order*, were to be considered as both natural and artificial; the lower group, the *variety*, was in general to be considered the product of cultural conditions. The *character*, or definition of a genus (*Phil. Bot.* sect. 186) was of three grades, depending upon the amplification:

¹⁵ This publication, dealing with the larger, relatively simpler group, i. e. the genus, was a forerunner of *Species Plantarum*. In par. xxvii: "Species heic nullas trado; quas diagnoscere facillimum erit Botanico ex datis Characteribus; qui has desiderat ex meis principiis, eas partim in *Flora Lapponica* quaeret, sed maximum numerum ex *Horto Cliffortiano* petat". . . [I treat no species here; these can be easily distinguished by the botanist from the given characters; whoever wishes these species, based on my principles, will find them partly in *Flora Lapponica*, but for the greater part in *Hortus Cliffortianus*.]

¹⁶ B. D. Jackson, Authorship in the *Amoenitates Academicae*, *Journ. Bot.* 51: 101-103. 1913: "He [Linnaeus] (p. 102) plainly looked upon these productions as entirely his own."

(1) The *natural character* (189) was the basis of all systems, and included all possible *notae* of the genus, both macroscopic and microscopic (191), except for such common *structurae naturalissimae* as only idiots (59) bothered to describe. "The *natural character* is absolutely fundamental for the recognition of plants and cannot be neglected; it is, however a work of infinite labor before characters are evolved which accord with all the species of the genus. The experienced botanist alone (193) can best make the *natural character*, which should be drawn up from an accurate description of the *primae speciei*¹⁷, with which all other species of the genus should be carefully compared, in order to exclude all discordance. No character is infallible until it has been applied to all the species of the genus. Difference in structure of the fructification (92) is the basis of genera.¹⁸

(2) The *factitious character* distinguishes a genus from all other genera of the same artificial order (188). The few *notae* (which are taken from the *natural character*), suffice to distinguish genera. The *factitious character*, or *diagnosis* (188)¹⁹, as Linnaeus states, was defined by Ray (188): "the characters of a genus are not to be multiplied except from necessity, and not more are to be assembled than are necessary for definitely determining the genus." *Factitious characters* (190) have been proposed by those who introduce *notae* in an artificial method, by which they are able to distinguish genera placed within the same order; thus they were used by Ray, Tournefort, Rivinus, and many previous authors.

(3) The *essential character* (187) distinguishes the genus by a single peculiar or unusual character (such as the nectariferous

¹⁷ This is the only reference I have found in Linnaean literature to the "type method". It does not necessarily refer to the first species published under the genus in *Species Plantarum*.

¹⁸ Every *nota characteristica* depends on the *number, figure, proportion and place* of the differentiating parts of the fructification (86). These are: calyx (including glumes of grasses, spathes, bracts of aments, involucre of *Umbelliferae*, etc.), corolla (including petals and nectaries), stamens, pistils, pericarp (capsules, legumes, pomes, etc.) seeds, and receptacle. These various parts (167) of the fructification number 38. When multiplied by 4 (number, figure, situs, and proportion), 152 combinations are possible; by recombination of the 38 parts, there are 5776 possibilities, far more than sufficient for the number of genera.

¹⁹ This is the only instance where I have seen this term used by Linnaeus. It has been misapplied to the Linnaean specific name. At the present time it is used much in the manner of the *factitious character* of Linnaeus for a brief condensation of the description of a genus or of a species, but without the differential feature which was fundamental to the Linnaean specific name.

pores at the base of the petals in *Ranunculus*, or the capitate fruit of *Magnolia* with seeds pendent by threads (105). It is the easiest way to know plants, and is used to distinguish genera of close affinity in a natural order by one or two *notae*. It is selected from the *natural character*. "If the essential characters of all the genera could be detected the recognition of plants would be easy, but whoever thinks that he can know botany from the *essential character* to the neglect of the *natural character* deceives himself. In the detection of new genera, without the *natural character* there would always be doubt (191)²⁰."

The foregoing three characters of the genus—which have been quoted from *Philosophia Botanica*—show different human aims. The *natural character* represents the complete description of the genus, upon which the natural system could be based. This type is the basis of *Genera Plantarum*. The *factitious character* was a selection of characteristics, such as would suffice for separation of genera in an artificial system or key. It has been in use from time immemorial. The *character essentialis* represents the simplest method of recognition. This triple method of working out the genus, it will be seen, was also a prototype for the Linnaean treatment of the species.²¹

Genera were described in *Genera Plantarum*, and in conformity with the conciseness characteristic of Linnaeus, the genera were not again treated in *Species Plantarum*. The preface to *Genera Plantarum* contains a number of statements of importance in the Linnaean method, though the idea of fixity of species expressed in this early work was considerably modified in later years. The most important ideas (from our point of view) are perhaps the following:

²⁰ The question whether a generic character (in the modern sense) can delimit a genus *per se* arises constantly. The *essential character* of Linnaeus (such as thread-pendent seeds of *Magnolia*) was founded only on unusual structures.

²¹ The factitious, essential, and natural characters were briefly discussed by Thornton, *Elements of Botany* (1812) p. 83–85, without much understanding:

1. The *factitious character* is employed in tables to discriminate all the *genera* falling under each particular Class and Order (*Vide* our *British Flora*).

2. The *essential generic character* comprehends all the distinctions requisite to discriminate any *genus* from all the other genera in the world . . . the multitude of genera is great, amounting . . . to considerably more than 2000.

3. The *natural generic character* is a careful description of all parts of the fructification, as the *Calyx*, *Corolla*, *Stamina*, *Pistilla*, *Pericarp* and *Seed*; and this was what Linnaeus particularly prided himself in . . .

"Names of plants are generic and specific (in case there is more than one species in the genus). There are as many species as there are diverse forms produced by the Infinite Being in the beginning; these forms have produced descendents, but always similar, according to the known laws of generation, so that the species which we now have are no more than there were in the beginning. Therefore species are as many as there are diverse forms or structures of plants occurring today, excepting those in which habitat or some other cause has produced differentiation (i. e., *varieties*). Genera (section 6), therefore, are as many as there are common attributes next [in rank] to those of distinct species, such as were created in the beginning: this is confirmed by revelation, experiment and observation. Hence *all genera and species are natural*. We must attentively and assiduously, by observation, inquire into the limits of genera. These limits may be difficult to determine, but *confusion in genera means confusion in everything*. I inculcate on all true botanists, if stability in this art is to be desired, that *all genera and species are natural*; unless this principle is assumed there can be no soundness in the art.

Natural genera (section 10) being assumed, there are two requirements for maintaining them sound: that only true species and no others be placed in the genus; that each true genus be circumscribed by limits and terms which we call the *generic character*. No authority except dissection in the herbarium should be acknowledged.

Icones (section 13) are not recommended for determination of genera: before the development of the alphabet it was necessary for things to be expressed in pictures where speech was not possible. Upon written words a genus can be more firmly based, and it is not always practicable to publish a picture. In a given genus the shape and number of parts differs in the various species, and the position and proportion of the parts must be established with care. This cannot be done in an illustration unless figures of all species are given. Thus for fifty different species, there should be that number of illustrations. Therefore, to omit the differential characters and describe only similarities is far less work and easier to understand".²²

As Spring (op. cit.) states (1838, p. 88) most genera in practice are artificial, inasmuch as they do not actually represent the next entity above the species, but only the relative goal of easier classification. But all should [theoretically] be natural, since (1) they have natural entities [i. e., species] as their base, and are built up on the same principles as are species; and (2) genera must (of necessity) be set up if there is a similarity which affects the whole plant and not merely the individual parts, and if a disconformity (*Bildungsabschnitt*) or change in nature is suspected. The existence of genera in Nature is apparent only by induction. Di-

²² The reader will realize how difficult it is to illustrate a genus pictorially, and that illustrations of genera are almost invariably delineations of individual species. This question was discussed by a nomenclature committee in Journ. Bot. 30: 242. 1892: "But a picture can never show the special characteristics alone, which raise the genus above the other of its affinity. A genus only gains priority by a verbal diagnosis".

rect proofs of the existence of genera fail us. But this is true also of species and no one doubts that there are natural species. Both are abstractions (p. 89), for the individual alone appears bodily in Nature. That natural genera exist is shown in their unrestricted sense in the speech of various peoples. Everywhere one finds similar species consolidated under a single genus name, but seldom do vernacular names conform to true species (p. 90). Even among uneducated peoples, the pink, the rose, tulip, grass, the owl and the eagle are seen as genera. As natural history rose among the Greeks and Romans, genus names increased accordingly, while species were differentiated only by occasional and changeable names. It is, as a rule, easy to recognize concretely what differentiates and what binds together (p. 96); "but to find the exact point wherein things differ and where they are similar, and to explain the situation in measurable terms, is very difficult."

This question as to whether or not genera are "natural" came up at an early date, and still persists in some form or other.²³

²³ Cf. the question, "Which in your opinion is the more natural unit among the flowering plants, the genus or the species? (i. e., which of the two more often reflects an actual discontinuity in organic nature) by Anderson in the "Concept of the Genus", Bull. Torrey Club 67: 364. 1940. I believe that I was one of the few who replied that the question was meaningless, for the *genus* and the *species*—at least in Linnaean taxonomy—are both natural by assumption, hence the limits of these entities are represented by discontinuities. As revealed by the answers, the hypothetical question was understood as, "On the basis of *present* (or *past*) *taxonomic usage* is a discontinuity found between genera more frequently than between species?" The difficulty and necessary ambiguity in answering this question becomes apparent from Weatherby's statement in Rhodora 44: 160. 1942, "So long as we have to rely on judgment at all, the accuracy and soundness of any taxonomic category, definition or no definition, will be in direct proportion to the accuracy and soundness of the individuals who apply it".

It was precisely here that Lamarck differed from the Linnaean point of view, to quote from Lamarck, *Illustration des Genres*, p. xv. 1791 (in translation): "If Linnaeus, instead of attributing genera to Nature, had considered them as assemblages of species approaching one another in most respects, and at the same time of assemblages well detached from one another by artificial limits . . . he would have prescribed laws convenient for guiding the establishment of limits of these assemblages. By these laws he would have prevented and moderated the arbitrariness which exists among nearly all botanical authors, who, without any rule which suits them well, continually are making innovations. Some reunite many genera into one, but more often form several genera from the species of a genus already established, which they distinguish by certain considerations chosen for this genus alone. The essential object in the formation of genera is to diminish the quantity of names to be retained in the memory, a quantity which would be enormous if a simple name were given to each plant . . . Two forces must of necessity be taken into consideration in the establishment of genera, that is to say, in the distribution of separating lines which one chooses for the genera: 1) it is important that genera should not be too numerous in species; 2) genera must not be too much reduced, and they should comprise, as far

Thus, in Ortega's edition of *Philosophia Botanica* (1792), in the "Annotationes, Explanationes, et Supplementa" (p. 410) there is a discussion of the Linnaean precept, "*Omnia Genera et Species naturales esse, confirmant revelata, inventa, observata*". Of this phrase Ortega says:

"That species of plants were created by God at the beginning of the world and do not change into other species, and are therefore *natural*, and that they remain unchanged to the present day no sane person will doubt; the confusion which would arise from the change of one *Species* into another, to the detriment of mankind, would not be allowed by the most provident Maker. And *Genera*, inasmuch as they are composed of *natural species* might also be said to be natural: but that God, all powerful in creation, has made the *Species* of plants with similar marks and characters, so to be distinguished that all of these species fall into certain *Genera*, just as families are diverse from one another, I do not dare to affirm. *A posteriori*, certainly many *Species* are to be observed with so many characters, especially of the fructification, in turn consistent with or different from other *Species*, that they can readily be referred to the same *Genus* in conformity with our art. But on the other hand, there are individual *Species* which could in no way be associated with others to constitute a *Genus*. And the idea of a *Genus*, if I am not mistaken, always involves the idea of several species similar to one another, and

as possible, a certain set number of species". And p. ix: "Linné, wishing apparently to give to genera a consideration which they did not have, pronounced anathema against those who were assured that there were no genera in Nature. He had, without doubt, more ability in supporting his opinion by trenchant decision, and by the pretended axioms and laconic maxims with which he has filled his *Philosophia* and his *Critica Botanica*, than by solid proofs which alone would convince those whom he could not win over by authority; proofs that he always forgot to establish."

The opinion of Asa Gray was still different (*Structural Botany*, p. 323, 1879): "Constituted as the vegetable and animal kingdoms are, the recognition of genera or groups of kindred species, is as natural an operation of the mind as is the conception of species from the association of like individuals . . . The number of species in a group is immaterial, and in fact is very diverse. A genus may be represented by a single known species, when its peculiarities are equivalent in degree to those which characterize other genera . . . If only one species of Oak were known, the Oak genus would have been as explicitly discerned as it is now that the species amount to three hundred; and better defined, for now there are forms quite intermediate between Oak and Chestnut . . . (p. 324) So that the recognition of genera even more than of species is a matter of judgment, and even of conventional agreement as to how and where a certain genus shall be limited, and what particular association of species shall hold the position of genus".

Linnaeus gave the clever answer to this problem by stating that the genus was "natural", but that the limits could not be determined until all the species of the genus were known. He wisely left the differentiation of genera to a succeeding generation. The real question at hand is whether we wish to have all of our genera "natural", that is bounded by discontinuities, and I think that our answer, as it was with Asa Gray, is "No!" No more disastrous way could be found for destroying the stability of our nomenclature. In large genera only a very few species approach the theoretical boundary line against which the adjacent "unnatural" genera eventually impinge, the point at which there should be "conventional agreement as to how and where a certain genus should be limited". As in many other things, we must formulate here a compromise between the practical and the theoretical.

Linnaeus himself says (Canon 159): "There are as many genera as there are similar structures of fructification produced by diverse natural *Species*". The similitude cannot exist unless it is shared by at least two species, despite whatever Linnaeus may have precariously asserted in Canon 203. For of the species which he had considered as solitary, several have proved not to be so, since congeners have been detected in *Dodartia*, *Hydrophyllum*, *Corymbium*, and *Gloriosa*; as to the others it is prudent neither to assert or deny what may be their future status We do not wish to raise the nominal question whether plants have really been formed by God into *Natural Genera*; we rather offer the definition of a genus in the judgment of the learned, as follows: "There are as many genera as the *Natural Species* show different forms of fructification'."

The modern problem of the limits of genera thus had raised itself at an early date. Ortega (op. cit.), in discussing the statement of Linnaeus (Phil. Bot. 160) that "*artificial classes are a substitute for the natural until all the natural classes have been detected, and because many genera are as yet unknown, the limits of classes present the greatest difficulties*," says that the same, in his judgment is true of the limits of genera. If all plants (cf. Linnaeus, Phil. Bot. 77) show an affinity on either side, then that affinity would increase more and more if all species were detected. And he quotes from Oeder (Fl. Danica, Fasc. 2, introd. p. 12); "If we are really willing to confess, it is not allowed us or ever will be, to know the differences which exist between plants or to set up invariable limits of genera or of superior or inferior groups. Not only may the author of such limits modify these limits from time to time, but others may be led by sufficiently strong arguments to acknowledge these changes".

The younger Linnaeus, in the preface to *Supplementum Plantarum* (1780), was cognizant of some of the difficulties:

"I have tried, as far as possible, to make few new genera; whatever plants could be transferred to some genus already recognized without danger to the character essentialis, I have assigned to the genus, even though there might be only a single character in diagnosing them. In this respect I am in disagreement with many botanists of our time, who seem to be persuaded that *the genus produces the character*. For I have found in my experience, that too numerous genera unnecessarily extend the science, separate affinities, multiply difficulties in distinguishing the genera, and furthermore impede the perception of the character essentialis".

Thus the character or *nota* appeared—and this is true also in modern taxonomy—as a sort of "doctrine of signatures" which revealed to what genus the species was to be allocated. And the variation in human judgment in selection of characters and their

delimitation has produced a sort of fantasy which has its main significance and stabilization in the historical view which is called "usage". To this stabilization the "doctrine of descent" has not added as much as was anticipated in the late nineteenth century; as a matter of fact, by injecting the additional dimension of "time", the evolutionary point of view has sometimes complicated rather than simplified the situation, leading to many tenuous modifications of nomenclature based on theoretical phylogeny.

As A. P. DeCandolle explains it (*Théorie de Botanique* 187. 1813): "The second rule Linnaeus announces to us in his laconic style in the words *character non facit genus*, that is to say, in order to make a genus it is not sufficient to have any isolated character, taken from the fructification and separating one or many plants from those that resemble it, but it is also necessary that the plants themselves be distinguished from others and approach them in 'l'ensemble de leur végétation'. This sage principle is the veritable touchstone of genera, and should always be in the eyes of the naturalist". Cf. *Critica Botanica*, 169: "Characterem non constituere Genus, sed Genus characterem". [The character does not make the genus, but the genus makes the character].²⁴ The corollary is the Linnaean statement that the limits of a genus cannot be definitely determined until all the species of the genus are known.

As to any single character alone characterizing a genus, the opinion of Linnaeus was probably much like that of many modern botanists, such as that of Pittier (*Contrib. U. S. Nat. Herb.* 20, pt. 2:40. 1917): . . . "the differential characters of the genus (*Lonchocarpus*) are never absolute when taken singly . . . Every one of these characters, considered separately, will be found to be shared with other more or less related genera,

²⁴ Cf. the footnote in Ruiz & Pavon, *Fl. Peru. Prodr.* p. 41: "This genus (*Gilibertia*) and the preceding (*Tovaria*) were opposed by Cavanilles because, as he says, they were founded without any criteria. Though there may be only one species in *Tovaria*, he says there is nothing constant in *Tovaria stigmata peltata et septemfida* to be a generic character, since the number of parts of the fructification is *sometimes eight or rarely nine*, as was mentioned in the *Observ.* . . . It might be noted, as Ruiz has added, that there is no genus if there is only one recognized species . . . For it is well known to all that no generic character is well constructed, or at all stable, unless all species of the genus are discovered and recognized. For this principle Linnaeus, 'Botanicorum facile Princeps', set up Canon 193 in his *Philosophia Botanica*, where he says: 'No character is infallible until it has been applied to all the species of the genus.'".

but it is their concurrence upon which the genus *Lonchocarpus* is based". There seems to be such a thing as a generic character *per se* only in the relatively unusual *nota singularis* of Linnaeus.

The most important statements of Linnaeus as regards the Genus are in sections 169 and 170 of *Philosophia Botanica*, and these all tend to emphasize the relatively unstable limits of the genus as compared with the species:

"*Notae characteristicae* which serve for stabilization in a certain genus may be of little value in some other genus. For you know that the character²⁵ does not constitute the Genus, but the Genus the character; that the character flows from the Genus, and not the Genus from the character; the character is set up, not that the Genus shall be made, but that the Genus shall be known. Therefore the greatest botanical heresy is to set up innumerable spurious genera, to the detriment of botany. A genus is rarely observed in which some part of the fructification²⁶ is not aberrant. Many *genera ficta* have arisen from species diverse in some part of the fructification: e. g. in *Carduus*, *Euphorbia*, *Hibiscus*, *Ranunculus*, *Gentiana*, *Primula*, *Bidens*, etc. Unless this principle is assumed there will be as many genera as there are species".

Linnaeus has something to say, also, on the opposite side of the question:

"In many genera a *nota singularis*²⁷ of the fructification will be observed, but if it is not present in all the species of the genus, care must be taken that several genera were not originally included—for example, *Erica* and *Andromeda* were formerly placed in one genus, but the awned anthers are peculiar to *Erica*; *Aloe* and *Agave* formerly constituted a single genus, but the stamens of *Agave*, inserted on the corolla and not part of the receptacle, distinguish the two genera. The more constant a part of the fructification may be in many species, the more certain it is that a generic character (*nota*) is present [174]. In some genera one part, in other genera another part of the fructification will be found the more constant; but none are absolutely constant. If the flowers are the same, but the fruit differs, all other things being equal, the genera should not be separated [176]".

And in *Critica Botanica* (section 281):

"Generic characters [*notae*] used for [specific] *differentiae*²⁸ are absurd. The beginner, when he first starts to examine the fructification, finds so

²⁵ This term, as I have mentioned, is used in the sense of "generic" description; for the individual "character", in our sense, Linnaeus uses the term "nota".

²⁶ This Linnaean term includes also the flower.

²⁷ Based on the number, figure, proportion and site of various parts of the flower and fruit (Phil. Bot. 92) a triple classification is to be derived: *Naturalissimam*, *Differentem*, and *Singularem*, and upon these are based respectively the Natural, Factitious, and Essential Characters of the Genus.

²⁸ It should be emphasized here that the species within a genus were distinguished and delimited by the *differentiae* which were part of the specific name. This was not done for genera by Linnaeus, the genus being set up merely as a synthesis of species. The limits of genera are, in common experience, more vague and less easily drawn than are

many individual characters [notas singulares], almost infinite, that he believes that no one before him has examined the flowers, and that there are almost as many new genera as there are species; but when several years have passed in such examination, he first finds the essential generic characters, and begins to distinguish them. Then he easily falls into the other extreme, and has doubts in everything."

The following translated quotations from letters of Linnaeus (Hulth 1907-1912) provide a commentary:

No. 545. To Bergius, Dec. 12, 1770. "*Erica* is undoubtedly one of the most difficult of genera. If it is at any time to be worked out, I think the following would be necessary: 1) sufficient *differentiae specifica*, so that the species could be clearly and securely distinguished; 2) *correct descriptions* and *figures*; 3) synonyms, preferably from accurate figures. As far as synonyms are concerned, I think it is better to have a few sure ones, for many figures are uncertain, and when we do get them they are often distorted. To get figures accurately made here, has been and will always be impossible for me.²⁹ I believe that if you and I should go into partnership, that we would have most of the *Ericas*. You have seen how difficult, if not impossible it was to evaluate certain synonyms, until a great many species were made known. I could have sworn that your *E. Plukenetii* and mine were the same species if I had not seen both of them."

No. 620. Browallius to Linnaeus, Jan. 24, 1745. "From Kalm's letter I see how your *Peloria* has caused alarm in the ranks; but I really think you should not be troubled too much about it, since if it throws over some of the *principles assumed for setting up genera*, so much to the good. And you well know that you have never thought otherwise than, since genera are the work of man, that man can also be mistaken. But one should especially be careful of the dangerous statement that this species might have been produced after the Creation. Species the

the limits of individual species. Between many genera,—such as *Aster* and *Erigeron*, *Oldenlandia* and *Houstonia*, or *Rhynchospora* and *Dichromena*—the distinctions become merely academic, or indeed invisible. The situation may be compared to the contiguous or separated circles which illustrate the relationship of the orders in Linnaeus' Natural System (see discussion at the end of this paper) and which are graphic illustrations of his statement: "Natura non facit saltus. Plantae omnes utrinque affinitatem monstrant, uti Territorium in Mappa geographica". From a dynamic point of view we may think of genera as broadening concentric circles such as the rings formed by pebbles thrown into water: the initial impact representing the type species of the genus, and the resulting concentric rings the accretion of species through historical usage. Not until such a circle impinges upon other circles is the practical problem of generic limits involved. This problem may be solved by somewhat arbitrarily dividing the few transitional species which occur at the borderline, chiefly according to usage, between the component genera, or of combining the two genera into one. The first method gives us stability of generic nomenclature. The second leads us to eternal instability, in an attempt to complete the "chain of nature" or the "phylogenetic tree". In the flowering plants, at least, our progress does not seem to have been very marked during the past century.

²⁹ Linnaeus was never able to obtain funds at Upsala or Stockholm for sumptuously illustrated botanical works, such as were published in Holland or England. For further notations on synonymy and illustrations the reader is referred to succeeding sections of this paper.

Creator has determined through [unchanged] *propagation by seeds*. Genera are the first and smallest group of species, and they do no good except to bring simplicity into the study of elementary botany. And things should not seem too strange if a new observation discloses something that goes against previous rules. One must in such cases cling to Newton's rule: *against truths established on the basis of a comprehensive and certain experience, no objections are admissible except those drawn from experience; then first should a doctrine be offered, bounded by these limitations*. The same thing can happen in botany that we have seen in the history of magnetism, electricity, and endless other things".

As a final word on the Genus, I quote from A. P. DeCandolle's "Théorie de Botanique" (1813), p. 260-261, to show how much the understanding of Linnaean method had already gone astray.

"Generic characters vary, according to whether they represent a natural or an artificial order. Linnaeus distinguished two sorts of characters: one, which he called *essential*, stated only what he considered necessary to distinguish a genus from others in the same class; the other, which he called with reason *natural*, contained a short description of all the parts of the fructification. Distinction between these two types of characters was indispensable in an artificial system. One can, in an artificial order, understand very well the essential character of a genus without having the least idea of the real form or of its nature or relationships, which are what one finds in the natural character . . . all that one finds in the natural characters of Linnaeus is implicitly stated in the character of the family and the tribe . . . If a genus has several characters particular to it, one does not fear to use all: thus my generic characters are somewhat longer than the essential characters of Linnaeus, but we avoid also the descriptive or natural characters. The generic characters should be treated in a sequence similar to those of a family: 1) the reproductive structures, which are to be considered as the true distinctive character; 2) the vegetative organs; 3) observations peculiar to the genus and showing the natural affinities."

THE SPECIES

"The Ariadnean thread of the systematists terminated in *Genera*, but I have attempted to extend it so far as *Species*, for which I have made proper differentiae; so that by these differentiae they may endure, for all true recognition begins with the recognition of species. Whatever botanists had built formerly is now collapsed, for it lacked a suitable foundation. But a strong botanical science has grown up in the last eighty years, now so firm that there seems no possibility of its collapse. For there is a solid foundation of species and a definite certainty in genera; for if genera are confused, then everything is confused." Linnaeus, Introduction to *Species Plantarum*.

THE SPECIFIC NAME

The principle element of *Species Plantarum* was the polynomial specific name, and upon its construction Linnaeus lavished his

skill and placed his greatest emphasis.³⁰ The specific name was a series of descriptive words (*differentiae*) selected according to rules laid down in *Philosophia Botanica*, by which each species was to be differentiated at first glance from all others in the genus. This method had already been in use in Linnaeus' earlier works and in those of Gronovius and Royen, who were both under the tutelage of Linnaeus.³¹ Indeed these polynomials are the definition or boundaries of the individual Linnaean species, which represent units of practical usage within the "compendium" (i. e., "*Species Plantarum*") of virtually all previously published names, figures, and descriptions. In other words the synthesis of these names, figures and descriptions, together with associated herbarium specimens, constitutes the "species" of Linnaeus. It will be noted that these Linnaean species are in general more comprehensive than species of present usage. The Linnaean species was a somewhat arbitrary unit—according to our standards of today—separated from all other species of the genus by means of the *differentiae* within the specific name, the entire treatment being comparable to, or even identical with, our modern keys to the species within a genus. These specific names were arranged in numerical order, each preceded by the generic name, with a "trivial" name added in the margin. As an example, with synonyms and bibliographic references omitted, may be cited the first genus treated in *Species Plantarum*:

- | | |
|---|----------------------|
| 1. <i>Canna foliis ovatis utrinque acuminatis nervosis.</i> | <i>Indica.</i> |
| 2. <i>Canna foliis lanceolatis petiolatis nervosis.</i> | <i>angustifolia.</i> |
| 3. <i>Canna foliis lanceolatis petiolatis enervibus</i> | <i>glauca.</i> |

When genera came to be revised in *Species Plantarum* from their treatment in earlier Linnaean works, a revision of specific names was often necessary in order to provide adequate *differentiae*. Thus we have (p. 113):

- | | |
|--|---------------|
| 1. <i>Plantago foliis ovatis glabris, nudo scapo tereti, spica
flosculis imbricatis.</i> | <i>major.</i> |
| <i>Plantago foliis ovatis glabris. Hort. Cliff. . . .</i> | |

³⁰ Introd. Sp. Pl.: "To set up the essential characters for the specific name is not an easy task; for it requires an accurate knowledge of many species, a most attentive investigation of the parts, the selection of *differentiae*, and finally the proper application of the art of terminology, in order that the briefest and most effective name may be arrived at."

³¹ Introd. Sp. Pl.: "Differentias específicas antehac Plantis non paucis imposui in Flora Lapponica, Suecica, Zeylanica, in Horto Cliffortiana, Upsaliensi. Iisdem principiis institere Botanici Gronovius, Royenus, etc."

contrasted with a new species:

2. *Plantago foliis ovatis glabris, scapo angulato, spica flosculis distinctis.* *asiatica.*
[Here follows a short description].
3. *Plantago foliis ovato-lanceolatis pubescentibus, spica cylindrica, scapo tereti.* *Hort. Cliff.* 36. *Fl. Suec.* 123. etc. *media.*
4. *Plantago foliis lanceolato-ovatis pubescentibus subdenticulatis, spicis cylindricis pubescentibus, scapo angulato.* *Gron. virg.* 16. *virginica.*

The characteristics of the specific name and rules for its formation I have extracted from paragraphs in *Philosophia Botanica* (1751), together with some of the longer explanatory notes provided in "Critica Botanica" (1737).

256. A plant is perfectly named when it has a generic and a specific name. The idea of a species lies in the essential character by which alone the species is distinguished from its congeners. The *differentia specifica* contains the characters (*notae*) by which a species is distinguished from its congeners. Therefore the specific name contains the essential characters of the *differentia*.³²

257. The specific name should distinguish the true plant from all congeners. This is the fundamental rule for specific names; if neglected, all will be confusion. All nomina specifica which do not distinguish a plant from the congeners are false; and all nomina specifica which distinguish the plant from others not in the same genus are false. The *nomen specificum* is therefore the *differentia essentialis*.

258. The specific name makes the plant recognizable at first glance, since it contains the *differentia* inscribed in the plant itself. The *character naturalis* of a species is the *Descriptio*; but the *character essentialis* is the *Differentia*. I was the first to base *nomina specifica* on essentials; previously no *differentiae* of value had been set up. My *nomina specifica* are based on *Differentiae* taken from the *Descriptio*; from the *Differentiae* is traced out the *character essentialis* in which *nomina specifica* are constant. Some of the recent botanists, such as Royen, Gronovius, Guettard, and Dalibard have accepted this method in entirety; Haller, Gmelin, and Burmann have accepted it in part. To be excluded from the specific name are all accidental things not existing in the plant itself or things which are intangible, such as place, time, duration, or use.

282. Every *differentia* is of necessity derived from the number, figure, place and proportion of variable parts of plants. These four fundamentals are the same as in genera, and they are constant everywhere: in the

³² It would be quite possible to have a specific name without *differentiae*. Such, in general, were the pre-Linnaean specific names. Only in the Linnaean method did the specific names become mutually dependent on the adjacent specific names. More extended accounts of a species, such as a *descriptio*, might also have *differentiae*; but such as were selected for use in the specific name became the *differentia specifica*. Since in the specific name only restricted or essential *differentiae* were permitted, the *nomen specificum* became actually the *differentia essentialis* (cf. 257 and following sections).

[living] plant, in the herbarium, and in icones. (Critica Botanica: On these four fundamentals—number, figure, proportion and place—depend the external structure of the plant by which alone its difference from others is represented to us. It is these characteristics and no others which we represent in icones. It is these which we preserve in the herbarium, for all others may be accidental. • No character in any part of the plant which cannot be referred to one of these four, can we assume as perfect and certain).

283. Care must always be taken that the variety is not used in place of the species. This is a difficult problem and must be looked into with the greatest of care. Errors arise and we are frequently blind, the chief causes being as follows: 1) the diversity and variability of nature, never ceasing in its operation; 2) the diversity and peculiarities of regions and climates; 3) remote places of origin; 4) the brevity of human life, which by fate perishes at an early day. (Critica Botanica: Figure, number, proportion, and location give us clear ideas, nor do they ever fail us; but, assuming them to be of fundamental importance, it is necessary to apply them to stable and not variable parts. Figure, number, proportion, and location do vary in plants, though rarely, and not all at the same time, nor in all parts of the plant at the same time. They vary, though less than other characteristics, and not enough to cause structural differences. Thus the task of the botanist in *differentiae* is double: to distinguish varieties from species and to express in exact words the characters which are inherent in distinct species. . . . The botanist who is more accustomed to the herbarium than living plants thinks the smallest difference to be the character of a distinct species, but he who has gone through the fields finds new species more difficult to discover. Likewise, they who cultivate plants in gardens only, where plants often change, commonly believe that they have more species than actually is the case, if they do not take the trouble to examine wild plants. To prevent unnecessary species there is no more apt and certain method than: 1) a careful examination of all parts of the plant, especially the fulcra [i. e., stipules, bracts, etc.]; 2) careful study of the ovary in all its parts; 3) a search for the most apparent *differentiae* in related species, for Nature does not make a *saltus*, but commonly uses the same method in a single genus; 4) a search for affinities or diversities, if any, in species which have been placed under another and adjacent genus because of diverse habits; 5) cultivation in diverse soils, which often change species already transformed by culture).

To separate species or genera by a single character, if possible, has always been a goal of systematists, ancient and modern. Such a single character is seen in "*Eriophorum spicis pendulis*" in *Flora Lapponica*, and it constitutes a *nomen specificum essentielle*. Where several characters are necessary, the specific name becomes *synoptic*, as in "*Salix foliis subintegerrimis lanceolato-linearibus longissimis acutis: subtus sericeis, ramis virgatis*" of *Flora Suecica*. For these procedures, the following extracts from *Philosophia Botanica* and *Critica Botanica* are quoted:

288. The true *nomen specificum* is either *Synoptic* or *Essential*. *Nomina specifica* distinguish species definitely, easily, and with certainty. A selection should be made from all possible *differentiae* of the species, from which the most outstanding are chosen, so that, finally, the species will be clearly recognized. (*Critica Botanica*: The *nomen specificum* is worthless unless there is a primary characteristic taken from the *differentiae*, by which I can rapidly, surely, and easily distinguish the species from all others in the same genus. Therefore all *nomina specifica* are false and not genuine, which include other characteristics (*notae*) than those distinctive of the species, since then the treatment runs into a *descriptio*. If I find no characteristic [*nota*] alone peculiar to the species, it is necessary to look for a few characters common to a few species of the same genus, but not to all the species; and these characters being found, then one peculiar in a higher degree, until I finally come to the ultimate subdivision. Hence all specific names are said to be either *essential* or *synoptic*. The *differentia* may be partly essential, partly synoptic; for if I begin a specific name by synoptic division, as soon as possible I shall use an essential character by which the name may be readily shortened).

289. The synoptic name employs semi-dichotomous characters for the plants of a genus. Where the *notae essentialis* cannot be found, it is necessary to make the *differentia* by synopsis; therefore the synopsis is a substitute for the *differentia essentialis*. In large genera we must usually employ the synoptic method.

290. The *nomen specificum essentialis* (288) has a single character of differentiation, peculiar to this species alone. It is presented in one or two words, or as a single idea. When genera and species have been stabilized, limited by the *differentia essentialis*, we have reached the highest point in *re Herbaria*. This name commends itself in brevity, facility, and certainty. A synopsis should not be admitted into the *differentia specifica* when a *nomen essentialis* has been detected; when the *nomina essentialia* have been worked out, we have reached the final goal.

294. Whoever discovers a new species adds not only the *differentia* of this species, but emends the *differentiae* in other species of the genus, so that the species may be distinguished in posterity.

Closely bound up with this last statement is the practical usage of synonyms. Under section 318, Linnaeus mentions that the earliest botanists were content with generic names.

"Succeeding botanists applied names arbitrarily, but Caspar Bauhin (1622) combined the names of these previous authors and reduced them to 6000. The 'Curiosi', interested only in new plants, doubled the number of names which previous authors had made. Bauhin's 'Pinax' was continued by Sherard, and in 1728 he left it to Dillenius, who died in 1747 with the work still uncompleted. Haller, in various publications, elaborated the absolute synonymy of the plants of Switzerland. A work of absolute synonyms is of the greatest necessity to botanists, for if the name of one author is detected all [the synonyms] are known."

Among synonyms (319) the best name leads the list, and it should be so chosen by the author, either from among his own names or from someone else's. Synonyms (320) may be arranged

in two ways, either descending (from the oldest to the newest) or ascending (from the new to the ancient). In the *descending*, the author's name heads the list, and the synonyms are arranged chronologically, as with Haller and Dillenius. In the *ascending*, names are arranged by genera [i. e., not mixed], and these proceed from the more recent to the ancient; this form has most often been used by me.³³

With this account of the specific name and its differential function together with a very brief review of synonymy, we are in a position to treat the subject from the practical view of modern nomenclature. In 1939³⁴ I came to the conclusion that the recent change in the name of the northern red oak (*Quercus rubra*) was wholly unnecessary. And the same applies to many other Linnaean names that have been shifted about, chiefly, it seems to me, from a lack of understanding of the Linnaean method. The Linnaean treatment of the American oaks, with the exception of *Q. Phellos*, is reproduced here from the first edition of *Species Plantarum*:

- [p. 995] 6. QUERCUS foliis ovatis indivisis spinoso-dentatis glabris. *Roy. lugdb.* 8. *Coccifera.*
Quercus foliis ovatis dentato-spinosis, glandibus sessilibus. Sauv. monsp. 96,
Ilex aculeata cocciglandifera. Bauh. pin. 425.
Ilex coccifera. Cam. epit. 774.
Habitat in G. Narbonensi, Hispania. ♀
 7. QUERCUS foliis obovatis utrinque acuminatis sinuato-serratis: denticulis rotundatis uniformibus. *Hort. cliff.* 448. *Gron. virg.* 117. *Roy. lugdb.* 80. *Prinus.*
Quercus, castaneæ foliis, procera arbor, virginiana Pluk. alm. 309. *t.* 54. *f.* 3. *Raj. hist.* 1916. *Catesb. car.* 1. *p.* 18. *t.* 18.
Habitat in America boreali. ♀
 8. QUERCUS foliis cuneiformibus obsolete trilobis. *nigra.*
Gron. virg. 117.
Quercus folio non serrato in summitate quasi triangulo. Catesb. car. 1. *p.* 20. *t.* 20.

³³ A. DeCandolle. *Lois de la Nomenclature Botanique.* 1867, p. 8. "I may say, in commencing, that there is a certain inquietude today caused by the great complication of synonymy. The botanists with but little experience will not be greatly affected. They will not adopt new names unless the necessity for them is stated, or at least until they are sure that the names have been approved, after examination by many competent men. After all, synonymy is not without merit. It constitutes the history of the science. Completely given, in order of dates, it is often instructive and interesting . . . Will the increase of synonyms continue in the same manner for a long time? That does not seem to be at all probable."

³⁴ RHODORA 41: 521-524.

- [p. 996] β . *Quercus marilandica* folio trifido ad sassafras accedente. *Raj. Catesb. car.* 19. t. 19.
Habitat in America septentrionali. η
- rubra.* 9. *QUERCUS* foliis obtuse-sinuatis setaceo-mucronatis.
Quercus foliorum sinubus obtusis: angulis lanceolatis seta terminatis integerrimis vix divisis. Gron. virg. 117.
Quercus esculi divisura, foliis amplioribus aculeatis. Pluk. alm. 309. t. 54. f. 4. *Catesb. car.* 1. p. 23. t. 23.
 β *Quercus foliorum sinubus obtusis: angulis acutis seta terminatis: intermediis vix tridentatis margine integerrimo. Hort. cliff.* 448. *Roy. lugdb.* 80.
Quercus carolinensis, virentibus venis muricata. Catesb. car. 1. p. 21. t. 21. f. 1.
Quercus virginiana venis rubris muricata. Pluk. alm. 309. t. 54. f. 1.
Habitat in Virginia, Carolina. η
- alba.* 10. *QUERCUS* foliis oblique pinnatifidis: sinubus angulisque obtusis.
Quercus foliis superne latioribus opposite sinuatis, sinubus angulisque obtusis. Gron. virg. 117.
Quercus alba virginiana. Catesb. car. 1. p. 21. t. 21. f. 2.
Habitat in Virginia. η

With the help of Mr. Savage I examined the specimens of *Quercus* in the Linnaean Herbarium in London in 1937, representing the following trivial and specific names:

7. (Prinus) *Quercus* foliis obovatis utrinque acuminatis sinuato-serratis: denticulis rotundatis uniformibus.
Hort. Cliff. etc.
8. (nigra) *Quercus* foliis cuneiformibus obsolete trilobis.
Gron. Virg.
9. (rubra) *Quercus* foliis obtuse-sinuatis setaceo-mucronatis.
10. (alba) *Quercus* foliis oblique pinnatifidis: sinubus angulisque obtusis.

In *Q. Prinus* and *Q. nigra* the specific names were taken over without change from their usage in *Hortus Cliffortianus*, Gronovius' *Flora Virginica*, and Royen's account of the Leyden Garden. In the case of *Q. rubra* the synoptic specific names from these same sources were combined into a simple essential name according to the rules laid down in section 290 of *Philosophia Botanica*, but one of the synoptic names was retained as the var. β ., which was differentiated by the somewhat 3-toothed apices of the leaf lobes. The specific name of *Q. alba* was a modification of the Gronovian name to form a better differential with the European *Q. Robur*. It should be noted that the older

specific name now has become a synonym. It is of great importance to recognize that the individual Linnaean synonyms were *nomina*, often used successively in various publications for objects of entirely different origin (often from our present point of view applied to objects which we regard as representing distinct species). To Linnaeus they all represented variability within the same species. Such for example is *Quercus esculi divisura, foliis amplioribus aculeatis* derived by Linnaeus from the illustrations of Plukenet and of Catesby; in this case Catesby had used Plukenet's name for quite a different kind of oak. It is quite evident that the Linnaean species was an aggregate of wild plants, as treated in *Flora Suecica*; cultivated plants, as in *Hortus Upsaliensis* and *Hortus Cliffortianus*; herbarium specimens in the Linnaean Herbarium, and those seen by Linnaeus in other herbaria; and lastly, figures and descriptions of which herbarium specimens were not seen. This is substantially the opinion to which C. B. Clarke³⁵ came, and likewise Spencer Savage, our foremost authority on Linnaean procedure³⁶:

"A considerable number of the plants described in the first edition of the 'Species Plantarum' cannot be said to have type-specimens in the ordinarily accepted sense. Linnaeus renamed and placed systematically a large number of plants that had been known to botanists for centuries,—a different thing from naming and describing a species for the first time. The Linnaean 'type' of any such well-known species will surely be found to consist of *all* the surviving herbarium specimens determined by Linnaeus at the time he wrote the diagnosis. A 'species' in Linnaeus's sense was not founded on an individual specimen, but was rather an intellectual concept of a natural group, even though that group was part of an artificial system. The specimens he determined he considered to be typical of such a group".

This subject will be discussed further under the heading of "Herbarium", but I wish to point out that the Linnaean species from one point of view was the synthesis of all bibliographic citations under the species, together with Linnaean herbarium specimens, whether or not they were associated with citations. From a second point of view, and a very important one, the species represented that portion of a genus which was included

³⁵ Journ. Linn. Soc. 30: 299. 1895. "Linnaeus conceived a species as an entity and did not suppose that it could be restricted to one 'type'. A 'species', in his Sp. Pl., is made up of 4 (or fewer) parts." See footnote 11.

³⁶ Catalogue of the manuscripts in the library of the Linnaean Society of London. Part II. Caroli Linnaei determinationes in hortum siccum Joachimi Burseri. Ed. Spencer Savage, 1937, p. 5.

under and defined by the specific name, of which the differential character has been discussed. It may be argued that this was not the idea of species of the present day, which in general are drawn on narrower lines. The corollary is that most species of *Species Plantarum* comprise two or more species as recognized in the modern consensus. It must be remembered that *Species Plantarum* was a tentative and artificial system. Natural species, as Linnaeus recognized, should be based on experimental cultivation, i. e., they were plants which came true to seed. But neither in Linnaeus' day or in the present day could a comprehensive classification be made on the basis of experimental data. The synthetic nature of species as treated in *Species Plantarum* was emphasized by the fact that the work was primarily without descriptions, and that reference to a description was made by the use of an asterisk.³⁷ "Only in obscure cases has it been necessary to add descriptions, and these are without ambiguity, so that I may keep the handbook acceptable to the beginner."³⁸

Especially as knowledge of the American and Asiatic floras increased, these Linnaean species were subjected to analytic treatments by later writers, and broken up into smaller units. As to the limits of species there is no unity even among botanists of the present day.³⁹ By Linnaeus himself specific names were corrected and restricted in succeeding editions of *Species Plantarum*.⁴⁰

³⁷ Cf. *Scirpus culmo nudo setaceo, spicis lateralibus subsolitariis sessilibus*. it. scan.* (Sp. pl. p. 49), and *Scirpus culmo triquetro nudo, umbella simplici, spicis ovatis*. Fl. zeyl. 38*. (Sp. pl. p. 50).

³⁸ *Introd. Sp. Pl.: Descriptiones tantum in obscuris adhibere necessum fuit, easque sine ambagibus, ut obtinerem compendium tironibus gratum*. Cf. RHODORA 41: 139-140. 1939. It is obvious that Linnaeus placed the asterisk after the word "DESCRIPTIONES", in ed. 2, to call attention to the fact that the sign meant a cited description.

³⁹ Bentham, perhaps the greatest of systematic botanists (Trans. Linn. Soc. 27: 507. 1871): "whether we follow Closs in breaking it (*Cassia Candolleana*) up into three species, or with Vogel regard it as a single representative species, or, as suggested by some others, reduce it to a variety only of the widely spread *C. bicapsularis*, its geographical and natural relations remain the same. I have, in the following enumeration, after much hesitation classed it as a variety; but all that is thereby meant is that, upon weighing all the evidence afforded by the materials at my disposal, it has appeared to me that its relationship to the other forms of *C. bicapsularis* is rather of that degree which botanists whose views I adopt call varieties than of the remoter degree which they term species."

⁴⁰ Thus in the second edition of *Species Plantarum*, *Scirpus geniculatus* was restricted to the plant with articulate culms and elongated spikes, whereas in the first edition it had included also the round-headed plant, *Scirpus (Eleocharis) caribaeus*

Several fallacies have crept into the interpretation of Linnaean procedure, one being that a new specific name ("diagnosis") is based on herbarium specimens at hand.⁴¹ Such a new specific name was (as previously mentioned) either 1) a new name constructed according to the rules in *Philosophia Botanica*, as in the example (*Quercus foliorum* . . . *divisis*) in Gronovius' *Flora Virginica*, 117 (1739):

Quercus foliorum sinubus obtusis, angulis lanceolatis seta terminatis integerrimis vix divisis.

Quercus Esculi divisura, foliis amplioribus aculeatis. Plukn. Alm. p. 309, t. 54, f. 4. Red-Oak. Catesb. Hist. Carol. vol. I. t. 32.

Quercus rubra seu Hispanica hic dicta, foliis amplis varie profundeque incisis. Clayt.;

or 2) a shortening of the specific name from synoptic to essential form (cf. *Quercus foliis obtuse-sinuatis setaceo-mucronatis*. Sp. Pl. p. 996); or 3) change in an adjacent name due to interpolation of a new species into the genus. In the citation just made from Gronovius' *Flora*, the old specific name of Plukenet was taken up

(or *S. capitatus*, according to a specimen placed later by Linnaeus in his herbarium, but not according to the immature specimen which Linnaeus had formerly seen in the Gronovian herbarium and which formed the basis of the treatment in the first edition).

Following Gronovius, *Cerasi similis arbuscula mariana, padi folio, flore albo parvo racemoso* of Plukenet and Catesby was included by Linnaeus as a synonym under *Prunus floribus racemosis, foliis deciduis basi antice glandulosis* Sp. Pl. 473. 1753. This Linnaean species quite evidently included the species now recognized as *Prunus virginiana* L., *P. serotina* Ehrh. and *Itea virginica* L. Between the issue of the first and second editions of *Species Plantarum*, Linnaeus realized that the Plukenet figure represented *Itea virginica*. Torrey & Gray, Fl. N. Am. 1: 410. 1840, discussed the situation as follows: "The *Prunus Virginiana* of Linnaeus was founded on the present species (the Choke-Cherry), as appears from his description [i. e., specific name] and herbarium: but the synonym adduced from Gronovius relates to the succeeding species [*P. serotina*] that of Plukenet (omitted in ed. 2) to *Itea Virginica* and that of Catesby (which was afterwards erased by Linnaeus in his own copy of the *Species Plantarum*) to *Cerasus Caroliniana*."

In passing, it might be mentioned that the difficulties in the interpretation of dioecious vines such as *Dioscorea* and *Cissampelos* from pictures and meager herbarium specimens was exceedingly difficult.

Plukenet's figure representing *Bryoniae similis floridana* listed by Linnaeus under *Dioscorea villosa*, Sp. Pl. p. 1033, represents the staminate flower of *Cissampelos Pareira*.

⁴¹ In the treatment of *Hedysarum violaceum* (Sp. Pl. 749) there is a new specific name, and one might say on the basis of this argument that Linnaeus had derived this new name ("diagnosis") from a specimen at hand, since a real *description* is appended to the treatment. But in discussing *Lespedeza violacea*, Britton (Trans. N. Y. Acad. Sci. 12: 62. 1893) says: . . . "as illustrated by his own [Linnaeus'] herbarium the species is complex, but the specimens are not the types of the species." The Gronovian reference [based supposedly on a specimen not to be found at the British Museum] is taken as the type. Schindler (Bot. Jahrb. 49: 587. 1913) intimates that Linnaeus had a Gronovian specimen under his eyes.

also by Catesby, but merely in a bibliographic sense, and applied by Catesby to a wholly different plant—as we see it today. This old Plukenet name now became a synonym. To this treatment was added the phrase from Clayton, which was in no sense a name or synonym, but merely a translation into Latin by Gronovius of the original English descriptive notes which accompanied the numbered (and unnumbered) specimens. It is quite evident from the much longer descriptive account of *Ruellia* (Fl. Virg. p. 73) that such descriptive notes were not specific names according to the Linnaean method under which Gronovius worked:

RUELLIA foliis petiolatis, fructu sessili conferto. *Linn. Hort. Cliff.* p. 318. n. 1.

Ruellia strepens, capitulis comosis. *Dill. Hort. Elth.* p. 300. T. 240. f. 321.

Ruelliae Species flore amplo coerulea inferne tubulato, superiore in quinque segmenta expanso, cito marcescente, in summo caule & ad nodos florens, foliis oblongis hirsutis serratis ex adverso binis, vasculo longo rotundo, bicapsulari, semine compresso. *Clayt. n.* 85 & 98⁴².

(To be continued)

SENECIO SMALLII Britton, forma **tristis**, f. nov., ligulis nullis.—VIRGINIA: a single clump at the dry border of "Ram-hole Swamp," Seward Forest, near Triplett, Brunswick Co., May 12, 1945, *Fernald*, no. 14,859 (TYPE in Herb. Gray.).

As I have elsewhere predicted, sooner or later a discoid form may be found in any member of § *Aurei*, so that the character "discoid", as opposed to "radiate", is not a sound one for use in keys.—M. L. FERNALD.

⁴² A description of *Ruellia strepens* was first given by Linnaeus in *Mantissa* 2: 422. 1771.